ACL Injuries-Which Graft Do You Use?

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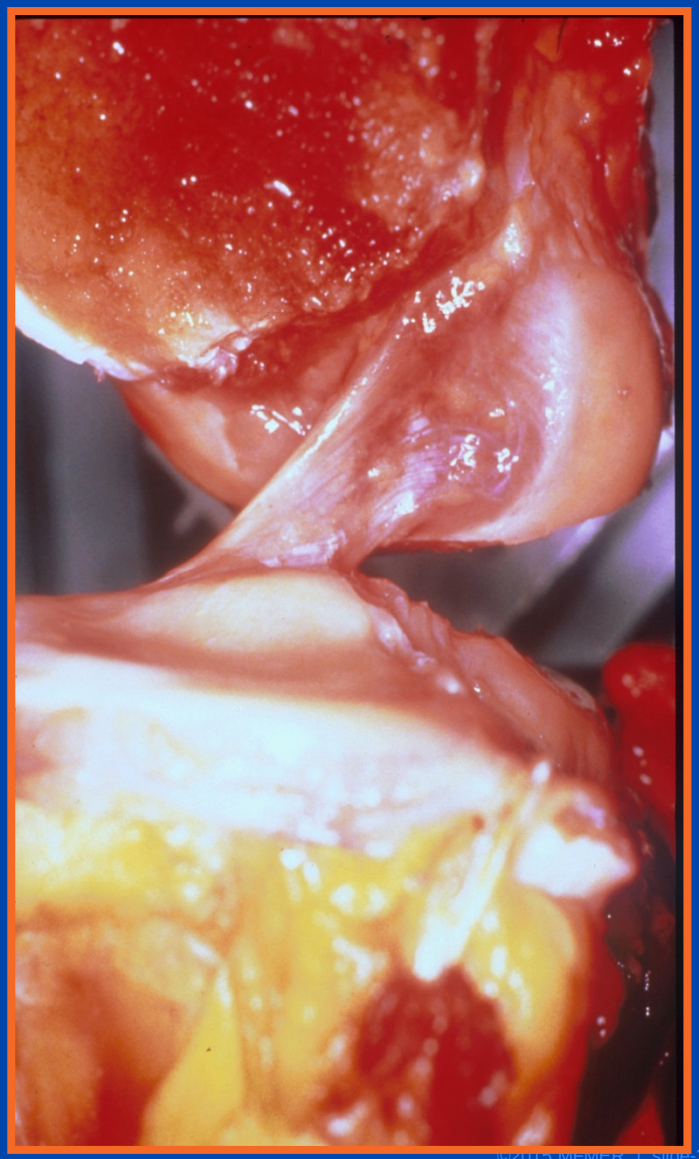
ACL Injury and Reconstruction

- 50% of all sports related knee injuries
- Limited data on primary repair and internal bracing
- Gold standard is reconstruction

“Ideal Graft”

1) Reproduces anatomy and biomechanics of native ACL
2) Allows rapid and complete biological incorporation
3) Strong initial fixation
4) Minimizes morbidity

Does it exist?



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Autograft Options

- Bone-Patella Tendon-Bone
- Hamstrings
- Quadriceps Tendon

-ipsilateral or contralateral

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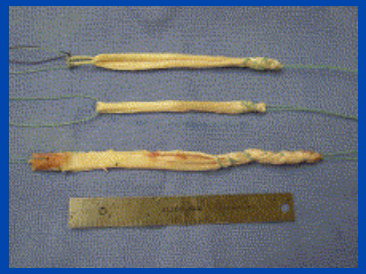
Allograft Options

- Bone-Patella Tendon-Bone Allograft
- Achilles
- Tibialis Anterior



*Have to consider graft processing/storage method

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Considerations

1) Strength
2) Stiffness
3) Cross-sectional area
4) Biological Properties

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Mechanical Properties

	Tensile Load (N)	Stiffness (N/mm)	Cross-sectional Area (mm^2)
Native ACL	2160	242	44
Autograft			
Bone-patellar tendon-bone	2977	620	35
Semitendinosus tendon	1216	186	14.0
Gracilis tendon	838	170	7.6
Quadruple hamstring	4090	776	53
Quadriceps tendon	2352	463	62
Allograft			
Bone-patellar tendon-bone	1403	224	
Achilles	1189	743	105
Tibialis anterior	3012	343	

*Adopted from data by Noyes et al,[13] West and Harner,[10] and Mehran et al.[6]

ACL indicates anterior cruciate ligament.

Lin, K et al. Sports Medicine and Arthroscopy, 2020

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Patellar Tendon Autograft

Advantages

- Mechanical/biological properties
- Initial fixation
- Decreased retear rates
- Faster Biological incorporation
    - Bone to bone healing

Park MJ, Lee MC, Seong SC. A 2001

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Patellar Tendon Autograft

Disadvantages- Graft Site Morbidity

- Patellofemoral pain BPTB = 42%

WHY?

Preexisting Degenerative cartilage?

Nonisometric graft placement?

Decreased quad circumference?

Postoperative flexion contracture?

Leys T, Salmon L, Waller A, et al. 2012

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Patellar Tendon Autograft Disadvantages

- Quadricep weakness
- Cosmesis
- Numbness/Dysesthesia incision site
- Patella fracture
- Patella tendonitis
- Patella tendon rupture
- Long term higher risk of arthritis?

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Contralateral BPTB

- **Theoretical Advantage**
  - Easier rehab
  - Earlier return to sport
- **Risk**
  - Symptomatic problem in uninvolved knee

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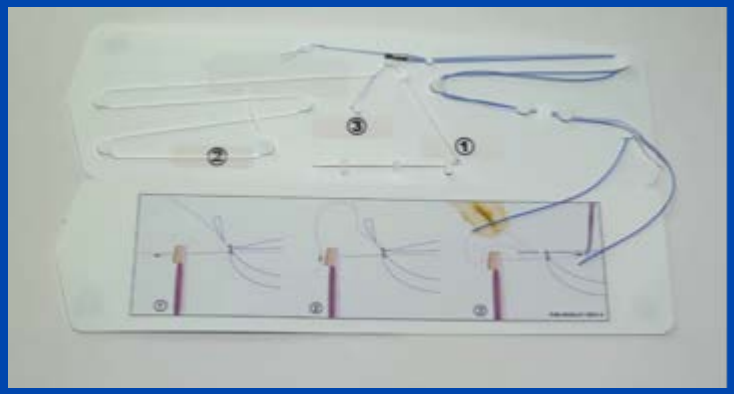
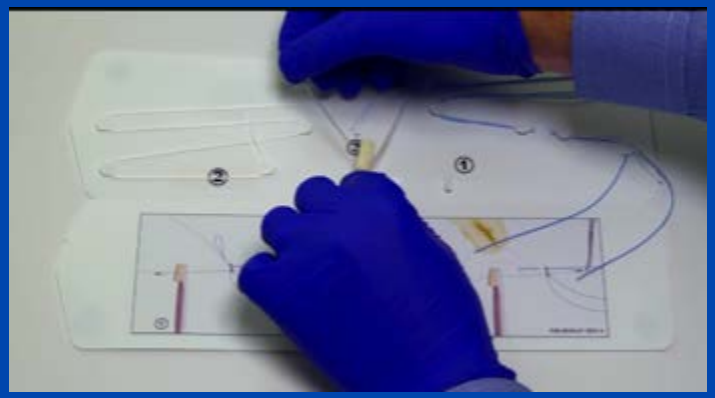
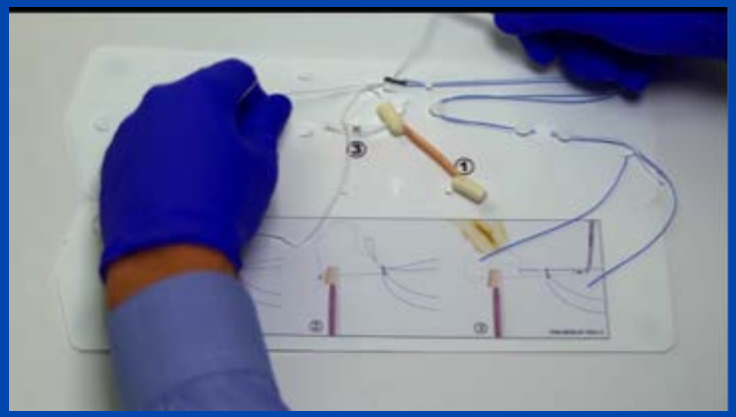
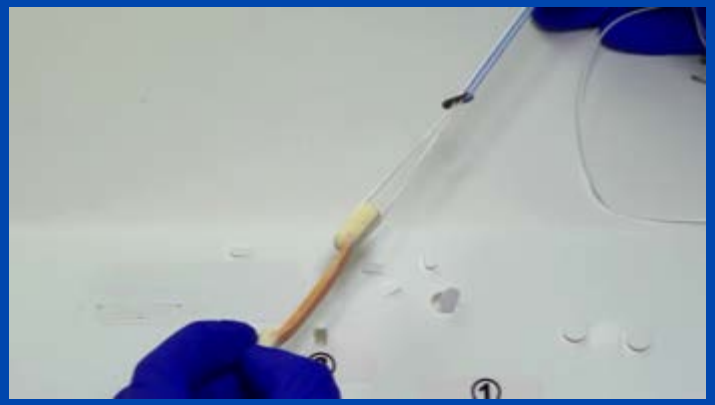
Graft Prep BPTB









https://www.arthrex.com/resources/video/yhw13PtuSEOVAAE3pX58EA/btb-tightrope

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Quadrupled Hamstrings

Advantages

- Preserves extensor mechanism
- Cosmetic
- No Graft Tunnel Mismatch

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Quadrupled Hamstrings

Disadvantages

- Some early failure-potentially due to longer period of graft integration
- Limited by size (augmented with allograft)
- Hamstring weakness-controversial
- Tunnel widening due to micromotion
- Some studies show greater rate of revision the patella tendon
- Persistent isokinetic deficits @ 18 months post-op

Tashiro *AJSM* 2003

Graft Prep Hamstring

https://www.arthrex.com/resources/animation/sjjf3PkEEeCRTQBQVoRHOw/speedwhip-technique-with-fiberloop

Quadriceps Tendon

Advantages

- Greater cross-sectional area
- Reduced risk of anterior knee pain
- Decreased risk of patella fracture (although bone block may be harvested from superior patella)
- No numbness
    - Avoids infrapatellar branch saphenous nerve

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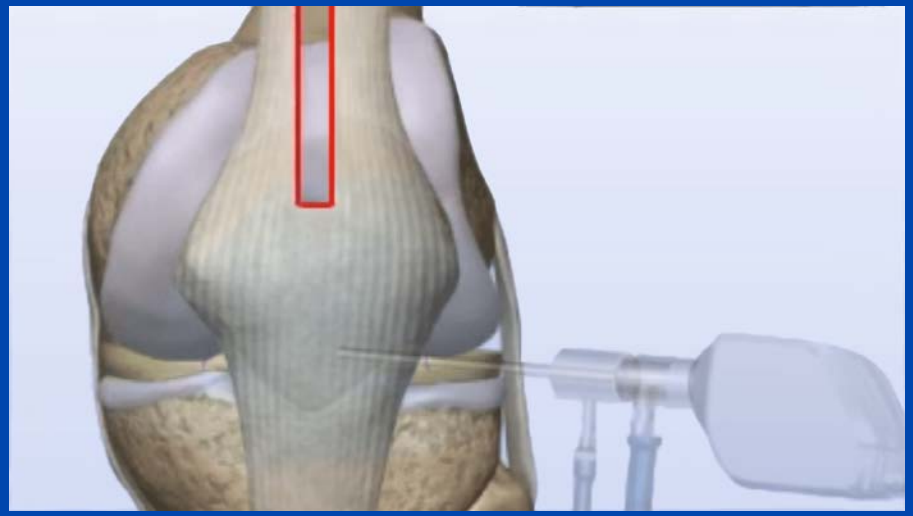
Quadriceps Tendon

Disadvantages

- Post op quad weakness
- Graft site morbidity
- Surgical technique
- More limited long-term data



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Allograft Considerations

1) Safety

- Concerns of rejection
  - Immune response in 35%
  - No clinically significant effects

    Harner, *Am J Knee Surg*, 1993
- Concerns of infection
  - Viral (1 in 1.5 million)

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Allograft Considerations

2) Allograft selection

- Patellar tendon
- Achilles tendon
- Tibialis anterior
- Hamstrings
- Other

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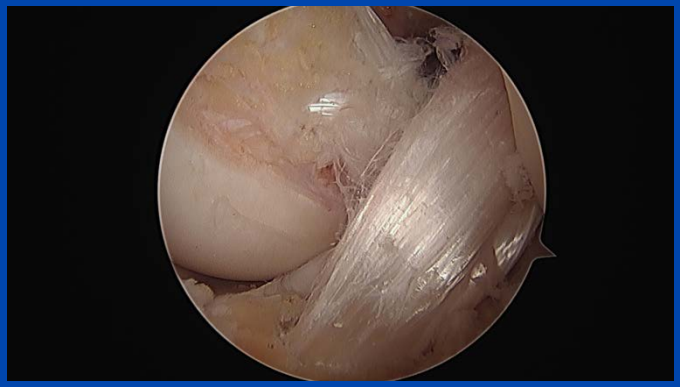
Allograft Considerations

3) Graft Incorporation

- Follows similar course to autograft tissue
- Cellular repopulation, revascularization, and collagen remodeling progress more slowly

DW Jackson, et al, CORR, 1996



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Allograft Considerations

4) Cost

- $1000 - $1500
- But decreased OR time

5) Availability

6) Post-op Rehab

- Less “aggressive”
- “Return to play” – 11-12 mos

7) Higher failure rate

- In young patients up to 25% of the time

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So How Do We Decide?

What is the right answer?

Scenario #1

21 y/o M college level football player injured during spring practice junior year presents with ACL tear, meniscus tear with no other ligament injury. Aspirations to continue to play football in future. Which graft choice is best for him?

a.) Quadrupled HS

b.) Allograft

c.) Quad tendon

d.) BPTB autograft

e.) ACL repair with internal brace

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How do we decide? BPTB

YES

- "High Demand"
- Young Athlete
- Football
- History of ligamentous laxity

NO

- Pre-existing patella pain/chondrosis
- jumping or deep squatting sports (relative contraindication)
- Lifestyle (job, religion)

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Scenario #2

15 y/o F high school soccer player with isolated ACL injury. No meniscal pathology. History of dislocation of R shoulder. Which graft choice is best for her?

a.) Quadrupled HS

b.) Allograft

c.) Quad tendon

d.) BPTB autograft

e.) ACL repair with internal brace

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How do we decide? Hamstring

YES

- Recreational athletes
- Return to play > 6 mos
- Cosmetic
- Open growth plates

NO

- Sprinters, speed athletes
- Increased ligament laxity

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Scenario #3

27 y/o M former hockey player with previously reconstructed R ACL with BPTB, presents with recurrent R knee ACL tear. Still playing ‘high level’ recreation hockey and wants to continue. Which graft choice is best for him?

a.) Quadrupled HS

b.) Allograft

c.) Quad tendon

d.) BPTB autograft

e.) ACL repair with internal brace

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How do we decide? Quad

YES

- Revision when you want to use autograft

NO

- Not primary graft choice with my surgeon
- ?change in rehab protocol
- ?bone block vs. soft tissue
- ?gold standard

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Scenario #4

45 y/o M with failed R knee ACL reconstruction with hamstring due to infection. Has had I&D and no evidence of infection. Had first stage revision with allograft bone grafting. Ready for re implant. Which graft choice is best for him?

a.) Quadrupled HS

b.) Allograft

c.) Quad tendon

d.) BPTB autograft

e.) ACL repair with internal brace

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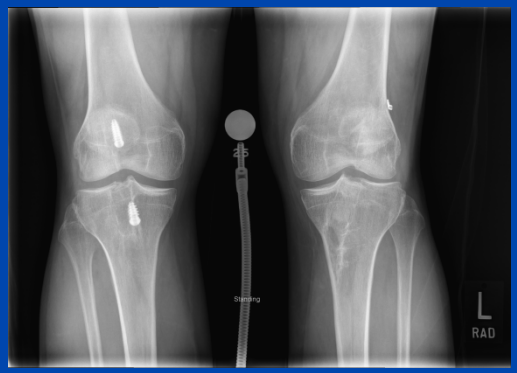
How do we decide? Allograft

1) Revision ACL

- Autograft already used
- Tunnel expansion
- May allow alternative techniques



2) Multi-ligament injuries

- Reduce surgical morbidity
- Reduce time and iatrogenic swelling

3) Primary ACL reconstruction

- Patient request
- “Older” patients (>40)
- “Lifestyles” – religion, occupation
- Special considerations
  - ligamentous laxity with “small” knees

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Summary

- **No ideal graft**
- **Must individualize**
  - **based on age, sport, expectations, and pre-existing pathology**
- **Trend is for autos in younger patients**
- **Studies can defend anything you do**
- **Need to discuss with patients!**
- **Be flexible !!!!!!**

"Use all graft types and have specific indications for each."

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MERRY
CHRISTMAS

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Thank You!